MLB

ENGINEERING

Professional Civil Engineer and Land Surveyor

Drainage Study

for

L - 15206 / ER07-01-004

Prepared for:

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(760) 723-9837

Project Site Address

39693 Calle De Luz

Prepared by:

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Date:

March 20, 2008

JN 06-sd120

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Contents

Section 1.
Discussion

Section 1.01 Purpose

The purpose of this study is to determine the anticipated 100-year storm runoff and required size of hydraulic structures to protect the proposed and existing slopes and structures on the site

Section 2. Project

Section 2.01 Description

The project is the grading for agricultural purposes on a 10-acre property located at 39693 Calle De Luz, Fallbrook, CA.

Section 2.02 Topography and Land Use

The surface of the land slopes away generally from the East to the West. Storm runoff currently collects in a natural drainage channel in the West end of proposed grading. **See Exhibit in Attachment A, sheet A-2.**

After development, the existing drainage pattern will remain essentially the same for the site.

Figure 1- Vicinity

Section 3. Methodology

Section 3.01 Rational Method

The Rational Method as described in the San Diego County Hydrology Manual, Section 3, (Revised June 2003) shall be used to determine storm runoff.

The Rational Method formula is expressed as follows:

$$Q = C\ I\ A$$

Where:

Q = peak discharge, in cubic feet per second (cfs)

C = runoff coefficient, proportion of the rainfall that runs off the surface.

The coefficient C has no units and is based on the soil group and the percentage of impervious area for the drainage sub-area. **Attachment H** includes calculations for the percent of impervious area for each drainage sub-area.

I = average rainfall intensity for a duration equal to the Tc for the area, (in/Hr.)

A = drainage area contributing to the design location, in acres

The following values are used in the calculations:

Soil Group B from San Diego County Soils Group Map. See **Attachment B**.

C (Coefficient of Runoff) from Table 3-1. See **Attachment D**.

100 year 6 Hr. Rainfall = 3.1" from . See **Attachment C**.

100 year 24 Hr. Rainfall = 5.5" from " " "

The site is first divided into drainage sub-areas. See the Hydrology Maps in **Attachments A.** The time of concentration, Tc, for each sub-area along the drainage path is computed based on the initial time of concentration for the initial area and the travel time to reach each succeeding node. Based on the time of concentration, the rainfall intensity is determined using Figure 3-2 (See **Attachment G**). Then applying the rational method equation, the peak runoff is determined at each node along the drainage path. Q's are tabulated at each node along the drainage path.

The rational method calculations are in **Attachment I**.

Section 3.02 Hydraulic Calculations

Hydraulic Capacity of structures and pipes is determined by use of the Mannings Equation.

The Mannings formula is expressed as follows:

$$V = 1.49(R^{2/3} s^{1/2})/n$$

Where:

V = velocity (ft./sec.)

R = hydraulic radius which h is determined by dividing the area of flow by the wetted perimeter (ft.)

s = slope of conduit or channel (ft./ft.)

n= Mannings roughness factor for the conduit or channel

For pipe flows, a mannings pipe calculator program is used to determine normal depth of flow, velocity, critical depth, and friction slope.

Section 4. Summary

Section 4.01 Post Construction Storm Runoff

Table 4.1 – Impervious Areas & Runoff Coefficients		
Drainage Basin Area	4.3	Ac.
Percentage impervious area before construction	0	%
Percentage impervious area after construction[A]	0	%
Total estimated runoff peak flow downstream of site after construction[B]	6.5	cfs

[A] Impervious Area Calculations, Attachment H.

[B] Ratonal Method Calculations, Attachment I.

The proposed project will not alter drainage patterns on the site or the surrounding area. The Storm water discharge points will not divert runoff from existing conditions. The rate of flow and the velocity of flow at the discharge point will not increase above existing conditions.

The following mitigation measures should be incorporated into the site grading to control erosion during construction and protect downstream properties from silt:

- Manufactured slopes and other disturbed areas should be protected by the use of mats, soil binders, wood mulching, or other approved temporary method until landscaping is established.

Section 5. Certification

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

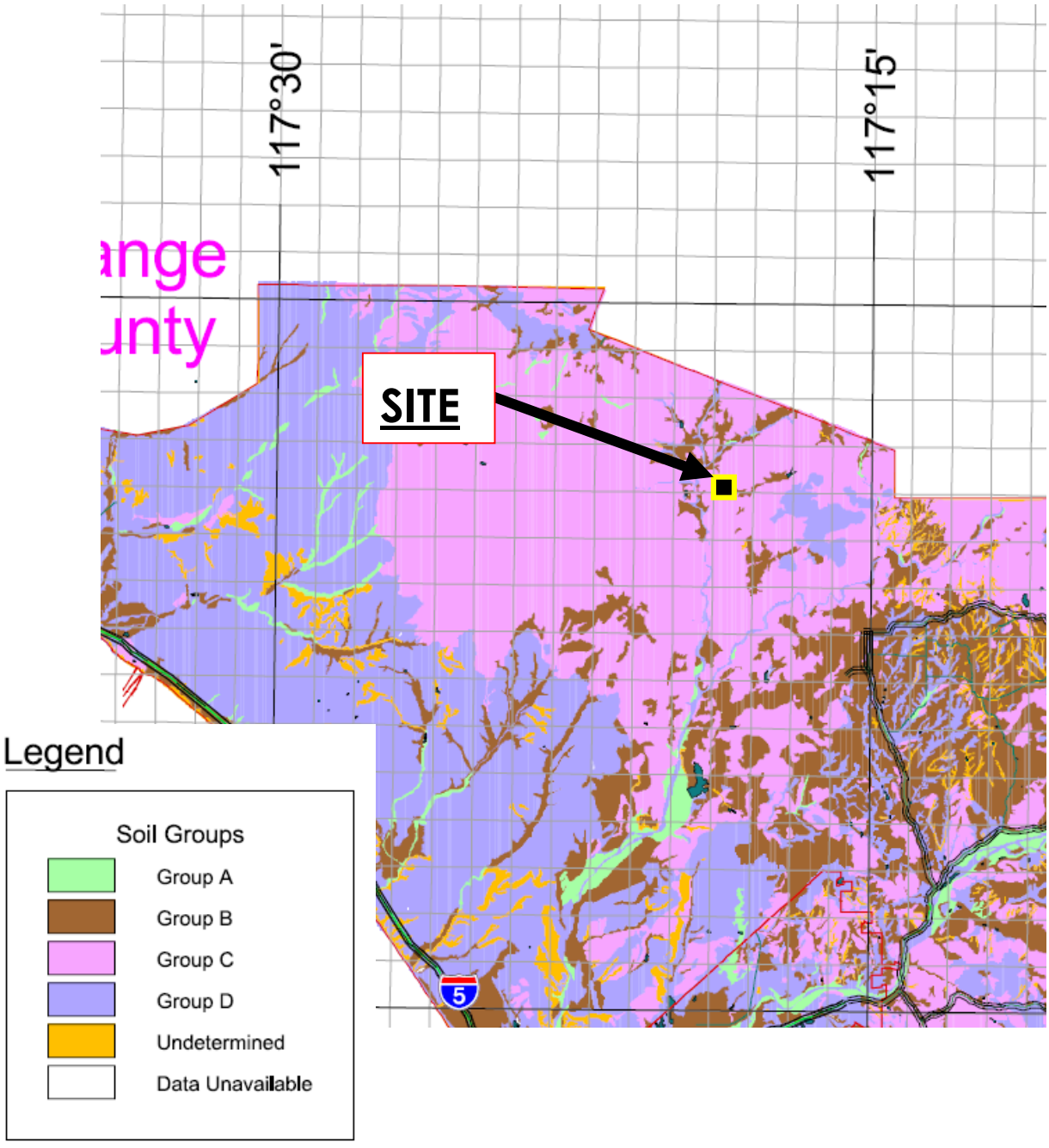
I understand that the check of project drawing and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

Michael L Benesh, RCE 37893 Date
Reg. Expires 3/31/09

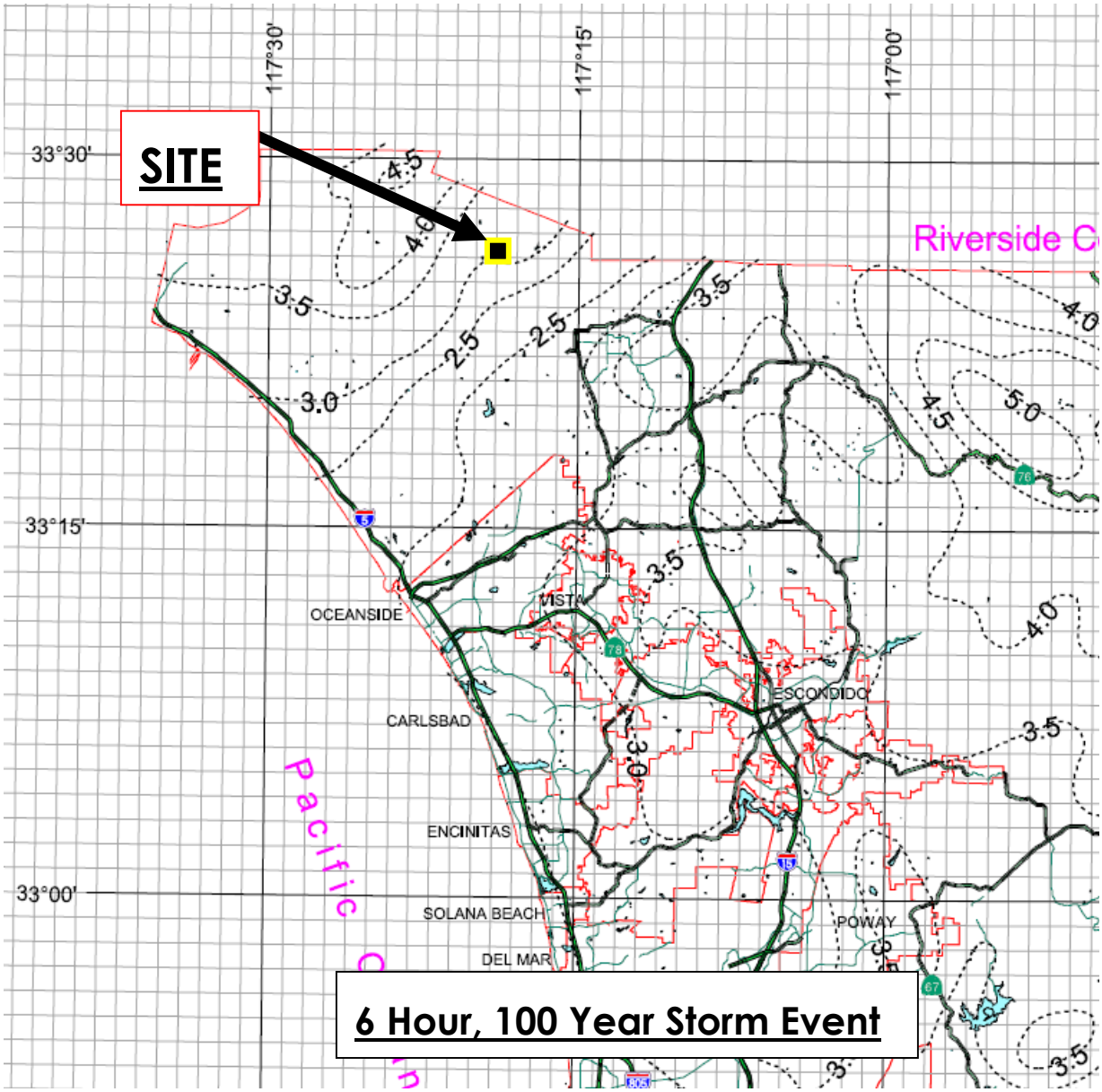
Attachment A - Hydrology Map

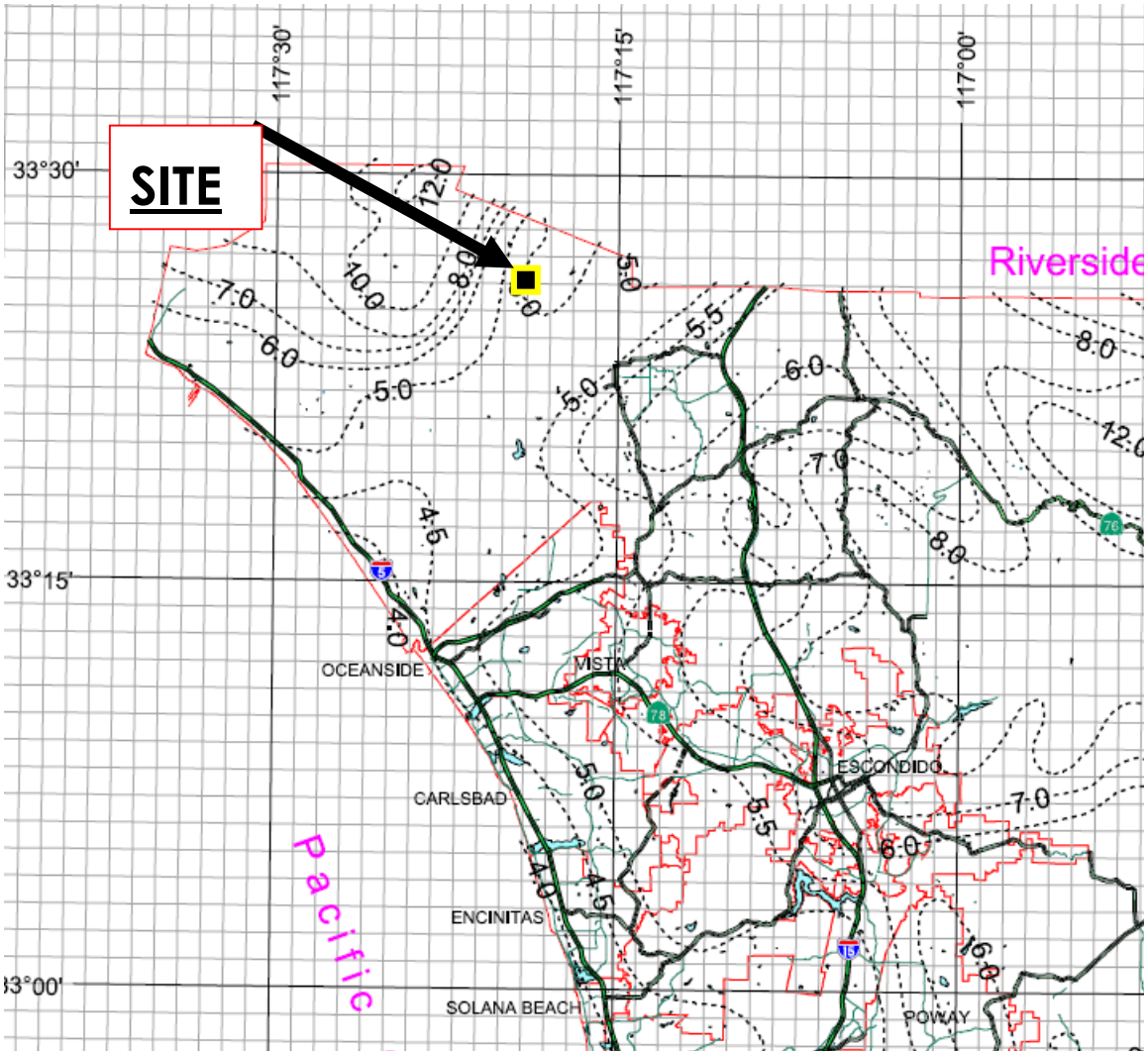
See map in folder at back of report.

Attachment B - San Diego County Soils Group Map



Attachment C - San Diego County Point Rainfall Maps





24 Hour, 100 Year Storm Event

Attachment D - San Diego County Hydrology Manual Table 3-1

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Attachment E - San Diego County Hydrology Manual Table 3-2

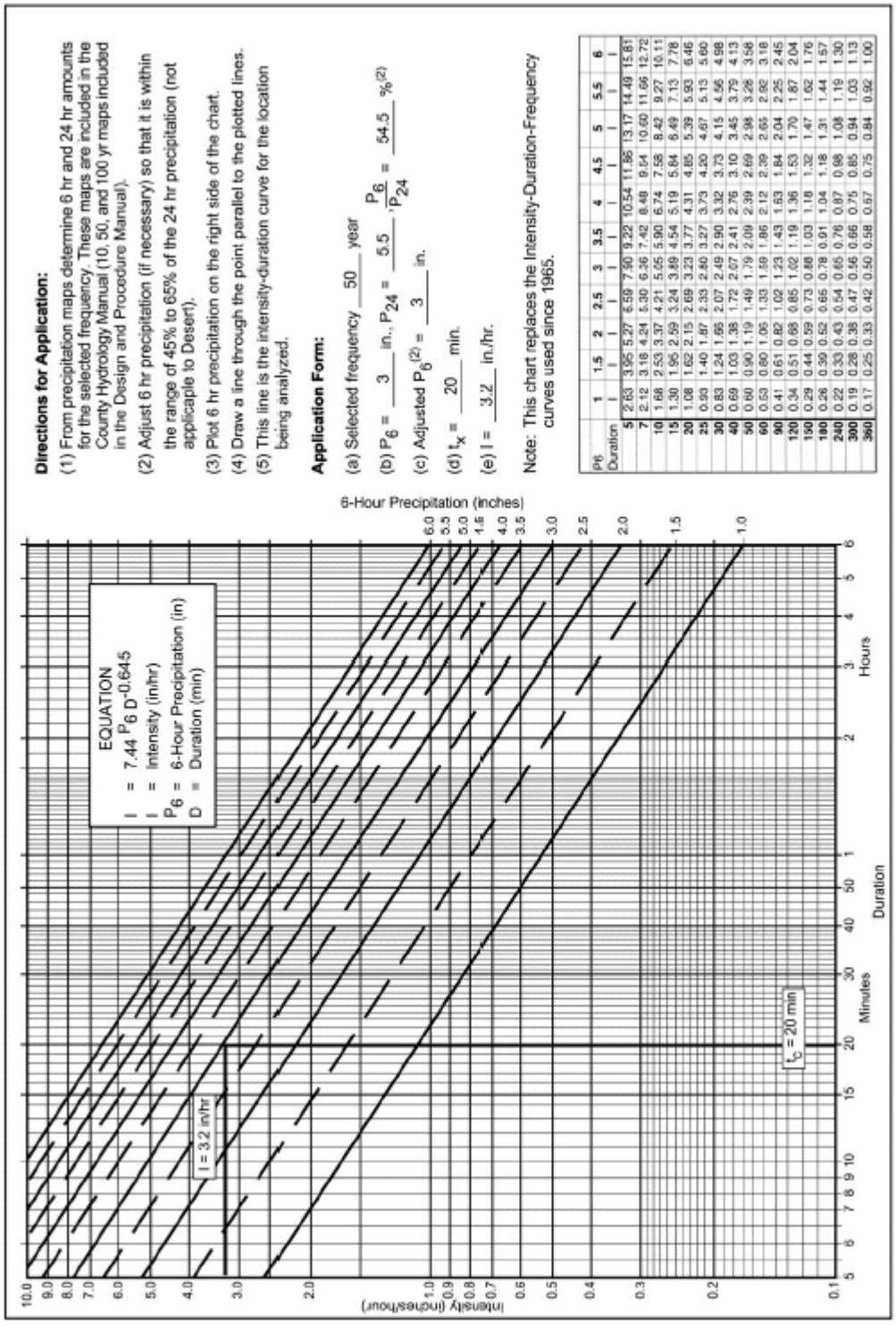
Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Attachment F - San Diego County Hydrology Manual Fig. 3-2

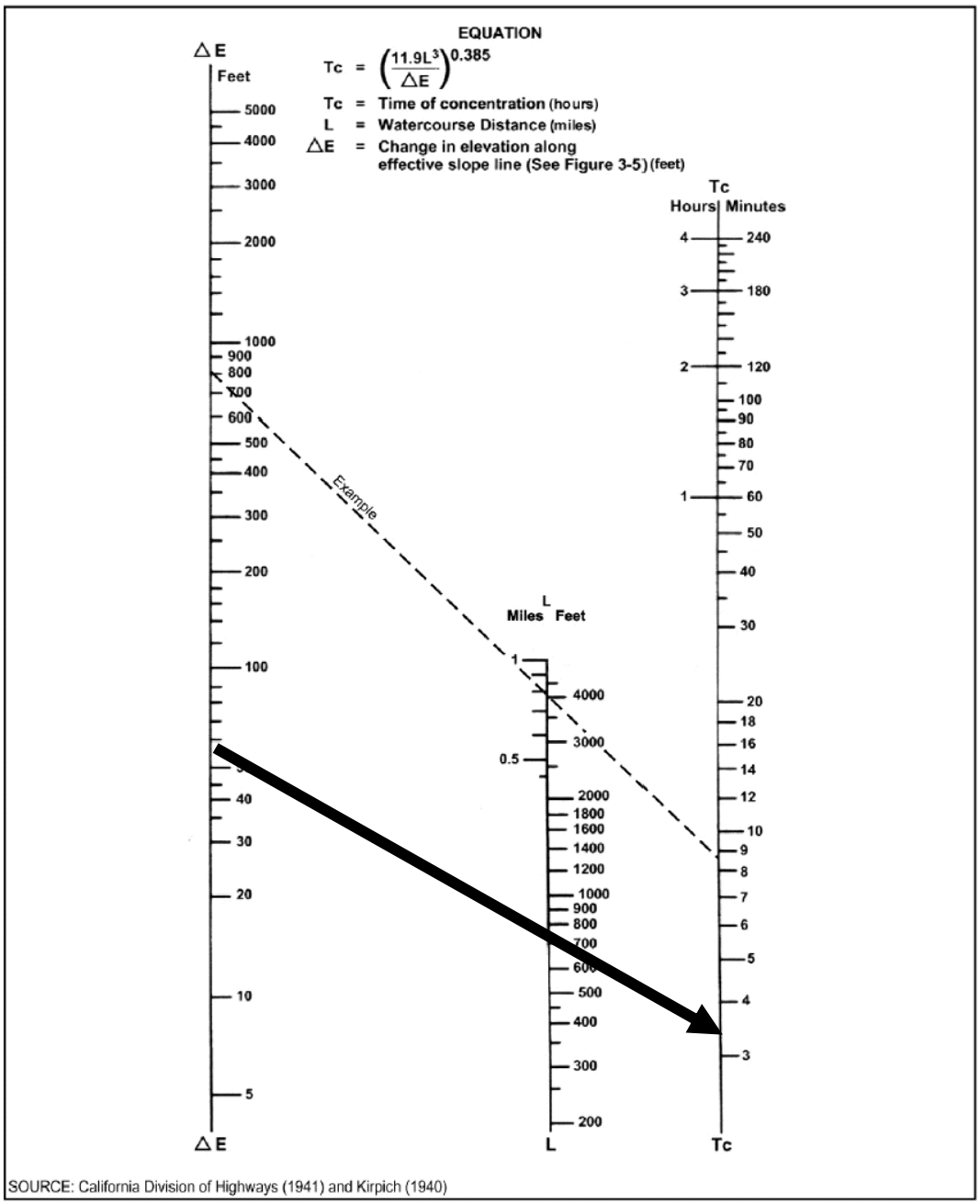


P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE **3-2**

Intensity-Duration Design Chart - Example

Attachment G - San Diego County Hydrology Manual Fig. 3-4



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

Attachment H - Impervious Area and TC Calculations

Node 100-101

Total Area 2.6 Acres
Impervious Area = 0.0 Acres
% Impervious = 0% (Use Low Density Residential - 1 DU/Ac)
Length = 800'
Slope @ Top = 2%
Ti= 10 min.
Lm=85'
Lt = 800 – 85 = 715'
H= 58'
Tt= 3.4 min (fig. 3-4)
Tc= 10 + 3.4 = 13.4 min.

Attachment I - Rational Method Calculation

See Following Sheet.

Rational Method Calculation Form
Project: L -

Frequency 100 Year
P6=3.0 in./hr.
Location: 33º22"13', 117º18"52'
Existing Proposed Condition

Calculated by MB
Date: Oct 17, 2006

Drainage Nodes	Soil & Development	A Acres	C	CA	ΣCA	I In./Hr.	Q CFS	Slope	Section	V '/Sec.	L Ft.	Tt Min.	Sum T	Remarks
100-101	C - 1 DU/A	4.3	0.36	1.55	1.55	4.19	6.5						13.4	See Attachment H

Attachment J - Hydraulic Calculations

Flow at End of Concrete Ditch D-75 (Node 101)

Manning Pipe Calculator

Given Input Data:

Shape	Elliptical
Solving for	Depth of Flow
Minor axis	24.0000 in
Major axis	36.0000 in
Flowrate	6.5000 cfs
Slope	0.1400 ft/ft
Manning's n	0.0150

Computed Results:

Depth	**3.8811 in**
Area	4.7124 ft2
Wetted Area	0.4942 ft2
Wetted Perimeter	28.0617 in
Perimeter	95.1927 in
Velocity	**13.1519 fps**
Hydraulic Radius	2.5361 in
Percent Full	16.1713 %
Full flow Flowrate	123.4370 cfs
Full flow velocity	26.1941 fps